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# Contributions to the knowledge of Strongylus circumlitus RAILLIET from the lungs of seals: the new genus Otostrongylus

Willemina M. de Bruyn

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Beiträge zur Kenntnis von *Strongylus circumlitus* RAILLIET aus den Lungen des Seehundes; die neue Gattung *Otostrongylus*

*Zoologischer Anzeiger* **103** (1933) 142-153

**Contributions to the knowledge of *Strongylus circumlitus* RAILLIET from the lungs of Seals; the new genus *Otostrongylus***

by Willemina M. de Bruyn

(Zoological Institute of Amsterdam University)

(with 8 illustrations)

Ms. entered 6 April 1933

A few years ago, a large number of nematodes were isolated from the lungs and pulmonary arteries of *Phoca vitulina* L. The seal, which was captured off the Dutch coast, had lived for a few months in the Amsterdam Zoological Garden. The nematodes were placed at my disposal by Prof. J.E.W. IHLE, whom I should like to thank for his steady assistance and good advice. The examination revealed that the nematodes were most likely juveniles of *Strongylus circimlitus* RAILLIET 1899. Prof. A. HENRY of the zoological college in Alfort near Paris kindly sent me for comparison the original drawings by Prof. A. RAILLIET (1899), along with other information, for which I should like to thank him as well.

Unfortunately he could not send the actual specimens, because they were lost when the building was occupied during the war.

A. RAILLIET described *Strongylus circumlitus* in 1899. The parasites which he examined (one male and a few females) were obtained from the right ventricle and the bronchia of a seal (*Phoca vit.* L.) caught in the "baie de Somme" in northern France. In 1913 A. RAILLIET and A. HENRY referred to *Str. circumlitus* as follows: " ...nous avons du reste fait connaître un Metastrongylide (de genre spécial voisin de *Dictyocaulus*) le *Strongylus circumlitus* (RAILLIET 1899), qui peut se rencontrer à la fois dans les grosses bronches et dans le coeur droit du *Phoca vitulina*." After this, no further reference was made to *Str. circumlitus*. YORK and MAPLESTONE (1926) and SPREHN (1932) do not mention this species. As far as we can tell from the drawings of A. RAILLIET, *Str. circumlitus* RAILLIET 1899 and the individuals collected in Amsterdam represent the same species. A. RAILLIET and A. HENRY intended to offer a new description of *Str. circumlitus* and establish a new genus for this species. However, the essay was never written. Since (as is clear from my description below) this nematode can not be placed in any previously known genus, a new genus is required. I propose to name this new genus *Otostrongylus*. The type species will then be *Otostrongylus circumlitus* (RAILLIET 1899). The name *Otostrongylus* refers to the two ventrally

directed processes on the dorsal rib of the bursa of the male, which resemble the ears of an animal.

First I shall describe *Otostr. circumlitus* (RAILLIET 1899), then I shall discuss the systematic placing of the new genus *Otostrongylus*.

## I. *Otostrongylus circumlitus* (RAILLIET 1899)

Syn. *Strongylus circumlitus* RAILLIET 1899.

Habitat: In the bronchia, the lungs, the right half of the heart, and the pulmonary artery of *Phoca vitulina* (L.).

Provenance: Baie de Somme (northern France), coast of Holland. Two hundred and ninety specimens (186 females and 104 males) were collected.

The animals are long and filamentous, and appear whitish in alcohol. The body narrows considerably towards the posterior end. No cross striation is visible on the cuticle. According to RAILLIET, the cuticle is very finely cross striate. On most animals, the cuticle is more or less swollen around the anterior end (Figure 1). Oral aperture without lips, with six (two lateral and four submedial) papillae (Figure 1).

A small, strongly chitinous mouth capsule is present (Figure 2). At the foregut/midgut boundary, the midgut exhibits two swellings (Figure 3).

The males have a length of 30-52.8 mm and a maximal width of 0.748 to 1.015 mm. RAILLIET reports for full-grown

males a length of 10.5 cm and a width of 1.260 mm. No other measurements are given by RAILLIET for males (except for the spicula). The above measurements apply only to the specimens collected in Amsterdam. The mouth capsule is 25-29 µ long with a maximal width of 147-155 µ. The foregut is 0.73-1.080 mm long with a maximal width of 0.107 to 0.125 mm. It represents ca. 1/41 - 1/53 of the total body length. The excretory pore is located 303-765 µ, and the nerve ring 294-742 µ, from the beginning of the foregut. Therefore the excretory pore is at the same level as the nerve ring or slightly farther back. The location of the nerve ring, and consequently of the pore, may be before, at, or beyond the mid-point of the foregut. The spicula are 338-534 µ long with a maximal width of 53-71 µ. RAILLIET reports a length of 840 µ. Thus, they are short and thick in relation to the entire body. They are slightly curved, with the concave side inward. In cedarwood oil, lactophenol or glycerol they appear perforated throughout (Figure 6). They are enclosed in a sheath and have a wing on the inside. The oval gubernaculum is 70-125 µ long with a maximal width of 42-51 µ. (It is not mentioned by RAILLIET, but it is clearly visible only in the lateral aspect [Figure 4].) A telamon is not present. The cloacal opening is located 125-259 µ from the end of the body. The bursa (Figure 4) is 267-481 µ long with a maximal width of 320-427 µ. It comprises two large lateral lobes and one very small dorsal lobe. The two

ventral ribs are fused over one-third of their length; the externo-lateral rib begins separately, but in close proximity to the other lateral ribs; the mediolateral

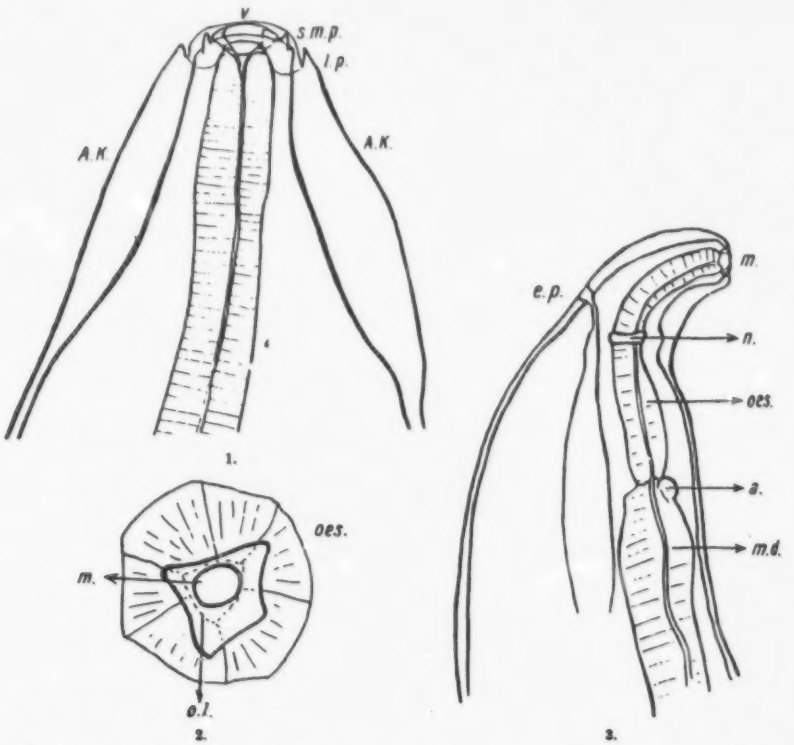


Figure 1. Anterior end of a male in ventral aspect. Magnification 280 (x 1/2). l.p.= lateral papillae s.m.p.= submedial papillae A.K.= swelling of the cuticle V.= mouth capsule
Figure 2. Frontal aspect of the head of a female. Magnification 280 x. m.= mouth o.l.= the triangular lumen of the foregut oes.= foregut
Figure 3. Sinistrolateral aspect of the anterior half of a female. Magnification 70 (x 2/3). m.= mouth n.= nerve ring e.p.= excretory pore oes.= foregut a.= swelling of the midgut m.d.= midgut

and posterolateral ribs are fused over one-third of their length; the externo-dorsal rib rises separately; the dorsal rib is undivided and forms a single, thick shaft which

terminates in three very blunt lobes and also has a ventrally directed distal process on each side (Figure 5).

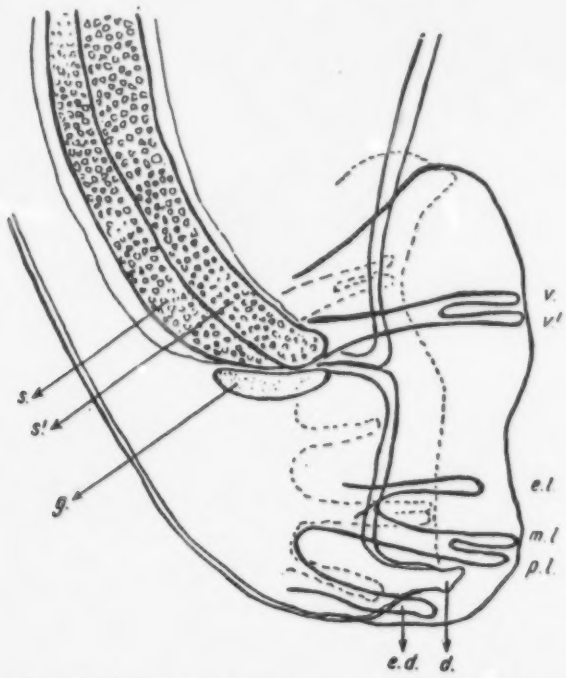


Figure 4. Dextrolateral aspect of the bursa of a male. The body wall is doubly outlined. Magnification 280 (x 2/3). v.v'.= ventral ribs e.l.= externo-lateral rib m.l.= mediolateral rib p.l.= posterolateral rib d.= dorsal rib l.d.= externo-dorsal rib g.= gubernaculum s.s'.= spicula

Females are 35-52 mm long with a maximal width of 0.641 to 0.926 mm. According to RAILLIET, the full-grown animals are 14-16 cm long and 1.8-2 mm wide. The mouth capsule is 21 to 29 µ long with a maximal width of 63-168 µ. The foregut is 0.854 to 1.068 mm long with a maximal width of 0.107 to 0.125 mm. It represents 1/35 - 1/48 of the total body length, and 1/75 in adults. Thus, the foregut lags behind in further growth in length. The excretory pore is located at a distance of 392-659 µ, and the nerve ring 374-641 µ, from

the beginning of the foregut. As regards the location of the excretory pore and the nerve ring, the same applies here as

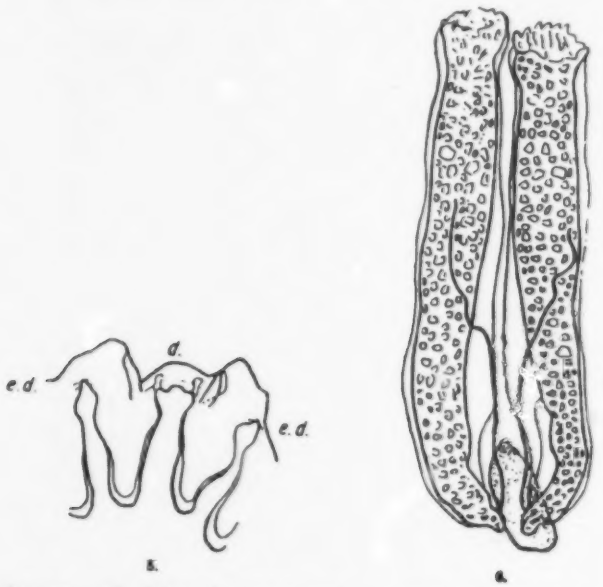


Figure 5. Part of the bursa of a male in dorsal aspect. Magnification 280 (x 2/3). d.= dorsal rib e.d.= externo-dorsal ribs
Figure 6. Spicula and gubernaculum of a male in ventral aspect. Magnification 280 (x 1/2). The specimen was first placed in potassium hydroxide solution, then in glycerol.

in the case of the males. The anus is 160-231 µ from the end of the body (350-425 µ in adults). The vulva is 1.86-2.59 mm from the end of the body, i.e., close to halfway. RAILLIET seems not to have observed the location of the vulva precisely; it is not shown clearly in the drawings. The vulva leads into a very small, short chitinous vagina from which the two uteri branch in opposite directions. Each uterus has an ovejector. The anterior uterine branch soon turns back, so that the genital organs are located mostly in the posterior part of the body (Figure 7). Neither eggs nor

embryoes were observed in the genital organs. Behind the anus, the body narrows sharply, terminating in a papilla, which has two apices in the lateral aspect (Figure 8). The cuticle exhibits swellings in various places on the posterior part of the body. However, these swellings are very irregular and do not appear to the same extent on all individuals. There are animals with almost no swellings, and others with very distinct swellings. The female shown in Figure 8 has medium-sized swellings.

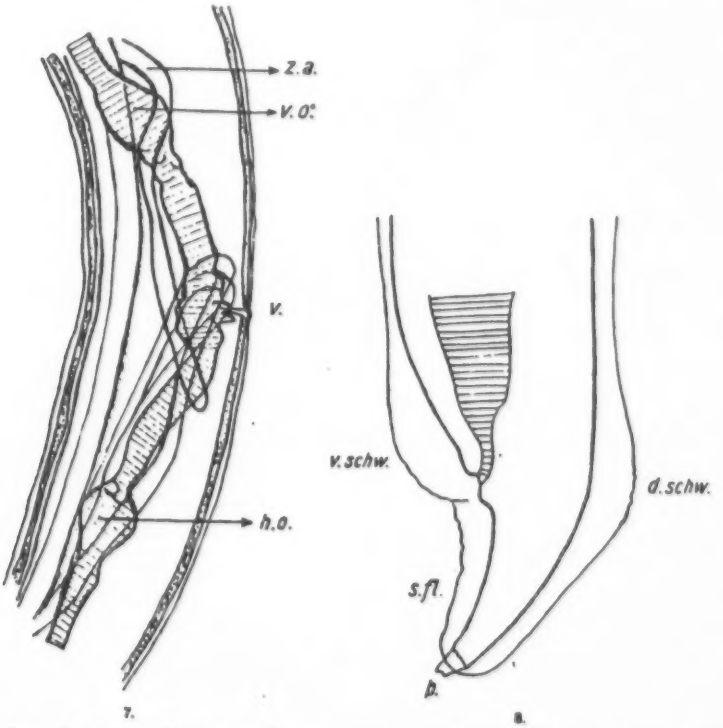


Figure 7. Dextrolateral aspect of part of the genital organs of a female. Magnification 70 (x 2/3). v.= vulva v.o.= anterior ovejector h.o.= posterior ovejector z.a.= reflexed branch of the anterior uterus.
Figure 8. Sinistrolateral aspect of the posterior end of a female. Magnification 280 (x 2/3). d.schw.= dorsal swelling v.schw.= ventral swelling s.fl.= lateral wing p.= papilla

Almost always, a distinct swelling is visible on the dorsal side at the level of the anus. Also on the ventral side, there is a more or less distinct swelling on almost all females. Moreover, the cuticle forms a pair of small, irregular, ventrally directed wings behind the anus. These wings, and the swellings frequently exhibit undulate folds.

According to RAILLIET, the females have a circular pigmented zone behind the anus. That is why he names this species "*circumlitus*". No trace of this zone was seen on the specimens collected in Amsterdam. Perhaps it appears later, or disappeared during fixation. According to RAILLIET, the female is viviparous. He also gives a brief description of the embryoes. They are 400 µ long and 22 µ wide. The body narrows somewhat anteriorly; the posterior end is thin and curved dorsally. The mouth is slightly eccentric and leads into a small tube which leads into the foregut. The foregut is 160-175 µ long, or 1/24 of the total body length. The anus is 45 µ from the end of the body. The cuticle directly behind the anus shows undulate folds.

## II. Systematic position

Authors disagree regarding the division of the family Protostrongylidae (= Metastrongylidae LEIPER 1908) into genera. NEVEU-LEMAIRE (1918), YORK and MAPLESTONE (1926) and

RAUTHER (1930) differentiate two families: n.l.[1] I. Metastrongylidae (LEIPER 1908) and II. Pseudaliidae (RAILLIET and HENRY 1916). The major difference between the two families is that the bursa is well developed in Metastrongylidae (with typical ribs) and reduced in Pseudaliidae (with atypical ribs). However, this difference is not constant, since the Metastrongylidae include also genera without any bursa (such as *Müllerius*), while the pseudaliid genus *Stenurus* has a fairly well developed bursa. Perhaps it would be better, with BAYLIS and DAUBNEY (1925), to abstain from dividing the Protostrongylidae; but at any rate, division into two families is uncalled-for. For the present, I believe that SPREHN's (1932) division is best, which differentiates the family Metastrongylidae (LEIPER 1908) into two subfamilies Metastrongylinae (LEIPER 1908) and Pseudaliinae (RAILLIET and HENRY 1909) and also appends the genera *Skrjabingylius* PETROW 1927 and *Filaroides* V. BENEDEN 1858 to the Metastrongylidae.

I shall now compare the previously known genera of Metastrongylinae with the new genus *Otostrongylus*. (The Pseudaliinae will not be included in the comparison, because their bursa is greatly reduced and supported by atypical ribs.) Since the compilation by YORK and MAPLESTONE (1926), very many genera have been added. Splitting of the genera in

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[1] (Translator's note) We could not find any meaning for this abbreviation which seemed to have an appropriate sense for this context.

this family has progressed very far. Almost always, we find the same characters distributed among the genera in different combinations. In the following list, the most important characters of each genus are shown in parentheses, and those which differentiate the genus from *Otostrongylus* are shown in italics. For more detailed comparisons, reference should be made to the original descriptions of the various genera (see bibliography). For the synonymy of the type species of genera 1, 2, 3, 4, 5, 9, 15 and 16, see the comprehensive work by SPREHN (1932).

1. *Metastrongylus* (MOLIN 1861) GEDOELST 1923.
Host: Pigs. In the bronchia.
Geographic distribution: Cosmopolitan.
Type species: *Metastr. elongatus* (DUJARDIN 1845).
Cuticle unarmoured; *lips present*; small mouth capsule; *papillae absent*; *dorsal rib duplicate*; externo-lateral rib separate from the other lateral ribs; *spicula long*; *gubernaculum absent*; telamon absent; *vulva near the anus*.

2. *Choerostrongylus* GEDOELST 1923.
Host: Pigs. In the respiratory passages.
Geographic distribution: Europe, Asia, Africa, America.
Type species: *Ch. pudendotectus* (WOSTOKOW 1905).
Cuticle unarmoured; *lips present*; small mouth capsule; *papillae absent*; *dorsal rib duplicate*; externo-lateral rib separate from the other lateral ribs; *spicula long*; gubernaculum present; telamon absent; *large cuticular swelling near the vulva and the anus*; *vulva near the anus*.

Genera 1 and 2 would perhaps be better regarded as subgenera (see YORK and MAPLE 1926). However, SPREHN (1932) and SKRJABIN (1924) have accepted the generic division.

3. *Protostrongylus* KAMENSKY 1905, syn. *Synthetocaulus* RAILLIET and HENRY 1907.
Host: Mammals. In the respiratory passages.
Geographic distribution: Europe, Africa, America.
Type species: *Pr. rufescens* (LEUCKART 1865).
Cuticle unarmoured; *lips present; mouth capsule absent;* dorsal rib undivided; *externo-lateral rib originating from a common shaft with the other lateral ribs; spicula long; posterior end of the male reinforced with a chitinous arch;* gubernaculum present; *telamon present; vulva near the anus.*

4. *Aelurostrongylus* CAMERON 1927.
Host: Carnivora. In the respiratory passages.
Geographic distribution: Europe.
Type species: *Ael. abstrusus* (RAILLIET 1898).
Cuticle unarmoured; *lips present; mouth capsule absent; papillae absent; dorsal rib cleft at the apex; externo-lateral rib originating from a common shaft with the other lateral ribs;* spicula short; gubernaculum present; *telamon present; vulva near the anus.*

5. *Angiostrongylus* KAMENSKY 1905, syn. *Haemostrongylus* RAILLIET and HENRY 1907.
Host: Carnivora. In the circulatory and respiratory organs.
Geographic distribution: Europe, North America.
Type species: *Ang. vasorum* (BAILLIET 1866).
Cuticle unarmoured; lips ?; *mouth capsule absent;* papillae ?; *dorsal rib cleft almost to the base;* externo-lateral rib separate from the other lateral ribs; *spicula long; gubernaculum absent;* telamon absent; *vulva near the anus.*

6. *Parastrongylus* BAYLIS 1928.
Host: Rodentia. In the stomach, but probably in the respiratory tract.
Geographic distribution: Ibadan.
Type species: *Parastr. tateronae* BAYLIS 1928.
Cuticle unarmoured; lips absent; *mouth capsule absent;* papillae ?; dorsal rib undivided; *externo-lateral rib originating from a common shaft with the other lateral ribs; spicula long; gubernaculum absent;* telamon absent; *vulva near the anus.*

7. *Elaphostrongylus* CAMERON 1931.
Host: Ruminantia.
Geographic distribution: Europe (Scotland).
Type species: *Elaph. cervi* CAMERON 1931.
Cuticle unarmoured; lips absent; *mouth capsule absent;* papillae ?; *dorsal rib cleft to the base; externo-lateral rib originating from a common shaft with the other lateral ribs;* spicula short; gubernaculum present; telamon absent; *vulva near the anus.*

8. *Varestrongylus* BHALERAO 1932.
Host: Ruminantia. In the bronchia.
Geographic distribution: India (Muktesar-Kumann, U.P.).
Type species: *Varestr. pneumonicus* BHALERAO 1932.
Cuticle unarmoured; *lips present*; mouth capsule very small or absent; papillae ?; dorsal rib undivided; externo-lateral rib separate from the other lateral ribs; *spicula long;* gubernaculum present; *telamon present; vulva near the anus*; a valve closes the vulva and the anus.

Genera 1-8, all with the vulva near the anus, differ from *Otostrongylus* in many characters. Genera 9-11, which

follow, are disregarded in my comparison because they have no bursa.

9. *Müllerius* CAMERON 1927.
Host: Ruminantia. In the respiratory passages.
Geographic distribution: Europe.
Type species: *Müllerius capillaris* (MÜLLER 1889).
Cuticle unarmoured; *lips present; mouth capsule absent;* papillae 6; *ribs absent; spicula long; bursa absent; gubernaculum absent; telamon present; vulva near the anus.*

10. *Filaroides* V. BENEDEN 1858, syn. *Pseudostrongylus* CAMERON 1927.
Host: Carnivora. In the lungs.
Geographic distribution: Europe.
Type species: *Filaroides bronchialis* (WERNER 1782 - V. BENEDEN 1858).
Cuticle unarmoured; lips absent; small mouth capsule; papillae 6; *ribs absent*; spicula short; *bursa absent*; gubernaculum present; telamon absent; *vulva near the anus.*

11. *Skrjabingylus* PETROW 1927.
Host: Carnivora. In the respiratory tract and in the frontal and ethmoidal sinus.
Geographic distribution: Europe.
Type species: *Skrj. nasicola* (LEUCKART 1842).
Cuticle unarmoured; lips absent; small mouth capsule; *ribs absent*; spicula short; *bursa absent; two caudal wings; gubernaculum absent; telamon present;* vulva in the middle of the body.

For the synonymy of the type species of genera 10 and 11, see the work by PETROW (1927; see bibliography).

The location of the vulva is not mentioned in the preliminary communication on genus 12, *Pneumostrongylus*. However, it is differentiated from *Otostrongylus* by very many characters.

12. *Pneumostrongylus* MÖNNIG 1932.
Host: *Aepyceros melampus*.
Geographic distribution: Africa (Transvaal).
Type species: *Pn. calcaratus* MÖNNIG 1932.
Cuticle unarmoured; *lips present; mouth capsule absent;* papillae ?; dorsal rib undivided, *with few terminal papillae*; externo-lateral rib separate from the other lateral ribs; spicula large; *gubernaculum absent; telamon present*; vulva ?.

All of the following genera have the vulva near the middle of the body.

13. *Troglostrongylus* (VEVERS 1922).
Host: Carnivora. In the frontal sinus.
Geographic distribution: India.
Type species: *Troglostr. troglostrongylus* VEVERS 1922.
Cuticle unarmoured; *lips present; mouth capsule absent;* dorsal rib undivided; *externo-lateral rib fused with the mediolateral rib over its entire length; spicula long, ending in hand-shaped expansions;* gubernaculum present; telamon absent; vulva in the middle of the body.

14. *Bronchonema* MÖNNIG 1932.
Host: Ruminantia. In the bronchia.
Geographic distribution: Africa.
Type species: *Br. magna* MÖNNIG 1932,

Cuticle unarmoured; *lips present; mouth capsule absent; papillae 4; dorsal rib duplicate;* externo-lateral rib separate from the other lateral ribs; *spicula long*; gubernaculum present; telamon absent; vulva near the middle of the body.

15. *Dictyocaulus* RAILLIET et HENRY 1907.
Host: Herbivores. In the bronchia.
Geographic distribution: Cosmopolitan.
Type species: *Dict. filaria* (RUDOLPHI 1809).

Cuticle unarmoured; *lips present; mouth capsule present; dorsal rib cleft almost to the base;* externo-lateral rib separate from the other lateral ribs; spicula short; gubernaculum present; telamon absent; vulva near the middle of the body.

16. *Crenosoma* MOLIN 1861.
Host: Insectivora, Carnivora. In the respiratory system.
Geographic distribution: Europe, North America.
Type species: *Cr. striatum* (ZEDER 1800).

*Cuticle armoured;* lips absent; mouth capsule present; dorsal rib undivided; externo-lateral rib separate from the other lateral ribs; *spicula long*; gubernaculum present; telamon absent; vulva near the middle of the body.

17. *Bronchostrongylus* CAMERON 1931.
Host: Carnivora. In the bronchia.
Geographic distribution: Belgian Congo.
Type species: *Bronch. subcrenatus* (RAILLIET and HENRY 1913), syn. *Haemostr. subcrenatus* RAILLIET et HENRY 1913.

Cuticle unarmoured, swollen at the anterior end; lips ?; *mouth capsule absent*; papillae ?; dorsal rib undivided; externo-lateral rib arising from the other lateral ribs; *spicula very long; gubernaculum absent;*

telamon absent; vulva approximately in the middle of the body.

Thus, *Otostrongylus* differs also from *Bronchonema* (14) and *Troglostrongylus* (13) in many characters.

Genera 15, 16, and 17 do not differ from *Otostrongylus* in as many characters.

*Otostrongylus* is differentiated from *Dictyocaulus* (15) by the absence of lips, the undivided dorsal rib, the presence of the cuticular swellings mentioned at the anterior end and at the posterior end of the female, and its host (Pinnipedia).

It is differentiated from *Crenosoma* (16) by the complete absence of any special armour on the cuticle and by the short spicula. Also, *Otostrongylus* has the cuticular swellings described, which are absent in *Crenosoma*.

*Otostrongylus* is differentiated from *Bronchostrongylus* (17) by the presence of a mouth capsule, the short spicula, the presence of a gubernaculum, the cuticular swellings at the posterior end of the female, and its size.

Therefore, *Otostrongylus* can not be classed in any known genus. It corresponds most closely to *Bronchostrongylus*. It is differentiated from all [previously known] genera by its special size (10-16 cm). It therefore requires a new genus:

telamon absent; vulva approximately in the middle of the body.

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Genera 15, 16, and 17 do not differ from *Otostrongylus* in as many characters.

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Therefore, *Otostrongylus* can not be classed in any known genus. It corresponds most closely to *Bronchostrongylus*. It is differentiated from all [previously known] genera by its special size (10-16 cm). It therefore requires a new genus:

18. *Otostrongylus* nov. gen.

Diagnosis: Cuticle unarmoured, more or less swollen around the anterior end. Lips absent; small, highly chitinous mouth capsule; six papillae on the head (two lateral and four submedial); male (10 cm long) with bursa; ventral ribs fused up to two-thirds of their length; externo-lateral rib separate from the other lateral ribs; mediolateral and posterolateral ribs fused up to one-third of their length; externo-dorsal rib standing separately; dorsal rib forming a single shaft terminating in three blunt lobes, with two other, ventrally directed processes; spicula uniform, short and thick, somewhat curved, with wings and a sheath; oval gubernaculum; telamon absent; female (14-16 cm) viviparous. Vulva near the middle of the body; posterior end with irregular cuticular swellings and lateral wings, ending in a two-pointed papilla.

Host: Pinnipedia. In the circulatory and respiratory systems. The embryoes were observed by RAILLIET throughout the intestinal tract. They were very lively and could live in water for a fairly long time.

Type species: *Otostr. circumlitus* (RAILLIET 1899) syn. *Strongylus circumlitus* RAILLIET 1899. Host: *Phoca vitulina* L.; in the right ventricle, bronchia, lungs, and pulmonary arteries. Provenance: Baie de Somme and Dutch coast.

The specimens are preserved in the Zoological Institute of the University of Amsterdam.

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